

thin film is not formed on the surface thereof and the flatness degree when the thin film is formed on the transparent substrate is equal to or less than $-2\text{ }\mu\text{m}$.

32. A photomask blank forming a thin film having a shading function and containing one or more transition metals or compounds thereof on a transparent substrate, wherein the thin film is formed by sputtering in which a sputtering target is disposed in a vacuum chamber into which an atmosphere gas has been introduced, the He gas content is 30 to 90 vol% in the atmosphere gas, the sputter target contains one or more transition metals or compounds thereof, and a deposition rate during the film formation by the sputtering is 0.5 nm/sec to 6 nm/sec.

33. The photomask blank according to claim 31, wherein the thin film contains one or both of carbon or oxygen in addition to the one or more transition metals or compounds thereof.

34. The photomask blank according to claim 32, wherein the thin film contains one or both of carbon or oxygen in addition to the one or more transition metals or compounds thereof.

35. The photomask blank according to claim 33, wherein the thin film is a laminated film comprising the shading layer containing one or more of the transition metals or compounds thereof, He and carbon, and an anti-reflective layer containing one or more of the transition metals or compounds thereof and oxygen.

36. The photomask blank according to claim 34, wherein the thin film is a laminated film comprising the shading layer containing one or more of the transition metals or compounds thereof, He and carbon, and an anti-reflective layer containing one or more of the transition metals or compounds thereof and oxygen.

37. The photomask blank according to claim 35, wherein the thin film has an oxygen content that continuously decreases and a carbon content that continuously increases from the thin film surface side to the transparent substrate side.

38. The photomask blank according to claim 36, wherein the thin film has an oxygen content that continuously decreases and a carbon content that continuously increases from the thin film surface side to the transparent substrate side.

39. The photomask blank according to claim 35, wherein the carbon content is 0 to 25 atomic% and the oxygen content is 0 to 70 atomic%.

40. The photomask blank according to claim 36, wherein the carbon content is 0 to 25 atomic% and the oxygen content is 0 to 70 atomic%.

41. The photomask blank according to claim 33, wherein the thin film further contains nitrogen.

42. The photomask blank according to claim 34, wherein the thin film further contains nitrogen.

43. The photomask blank according to claim 31, wherein the thin film has a crystal grain size of 1 to 7 nm.

44. The photomask blank according to claim 41, wherein a nitride film containing nitrogen and the same transition metal or metals contained in the thin film is formed between the transparent substrate and the thin film.

45. The photomask blank according to claim 42, wherein a nitride film containing nitrogen and the same transition metal or metals contained in the thin film is formed between the transparent substrate and the thin film.

46. The photomask blank according to claim 44, wherein the thin film has an oxygen content that continuously decreases and a carbon content that continuously increases from the thin film surface side to the transparent substrate side, nitrogen is contained in the

nitride film in a relatively greater amount than the amount of nitrogen contained in the thin film, and the amount of the transition metal decreases as the amount of nitrogen in the nitride film increases.

47. The photomask blank according to claim 31, wherein the thin film contains chromium.

48. The photomask blank according to claim 41, wherein the transparent substrate is composed of quartz glass.

49. A photomask on which a mask pattern has been formed by the patterning of the thin film formed on the transparent substrate of the photomask blank of claim 31.

50. A method of manufacturing a photomask blank, in which a sputtering target containing one or more transition metals or compounds thereof is disposed in a vacuum chamber into which an atmosphere gas has been introduced, and a thin film having a shading function is formed over a transparent substrate by sputtering,

wherein the correlation between the amount of helium gas contained in the atmosphere gas and the film stress of the thin film is determined before introducing the atmosphere gas into the vacuum chamber,

the helium gas content is determined from said correlation so that the thin film will have a film stress such that the mask pattern obtained when the thin film is patterned will have the desired pattern position precision, and the thin film is formed by sputtering in an atmosphere gas having this helium gas content.

51. A method of manufacturing a photomask blank, in which a sputtering target containing one or more transition metals or compounds thereof is disposed in a vacuum chamber into which an atmosphere gas has been introduced, and a thin film having a shading function is formed over a transparent substrate by sputtering,

wherein the thin film is formed at a deposition rate of 0.5 nm/sec to 6 nm/sec, and the atmosphere gas contains helium gas.

52. A method of manufacturing a photomask blank, in which a sputtering target is disposed in a vacuum chamber into which an atmosphere gas has been introduced, and at least a thin film having a shading function is formed over a transparent substrate by sputtering,

wherein the thin film is formed at a sputtering power of 950 to 3000 W, and the atmosphere gas contains helium gas.

53. The method of manufacturing a photomask blank according to claim 50, wherein the helium gas content is 30 to 90 vol% in the atmosphere gas.

54. The method of manufacturing a photomask blank according to claim 50, wherein the helium gas content is 40 to 65 vol% in the atmosphere gas.

55. The method of manufacturing a photomask blank according to claim 50, wherein the thin film further contains one or both of carbon or oxygen.

56. The method of manufacturing a photomask blank according to claim 51, wherein the thin film further contains one or both of carbon or oxygen.

57. The method of manufacturing a photomask blank according to claim 52, wherein the thin film further contains one or both of carbon or oxygen.

58. The method of manufacturing a photomask blank according to claim 54, wherein the thin film is a laminated film including a shading layer that contains carbon, and an anti-reflective layer that contains oxygen, and any one or both of the shading layer or the anti-reflective layer is formed by sputtering in an atmosphere gas containing helium gas.

59. The method of manufacturing a photomask blank according to claim 54, wherein a nitride film containing nitrogen and the same transition metal or metals contained in the thin film is formed between the transparent substrate and the thin film.